Amendments to the Drawings:

The attached two sheets of drawings include changes to Figures 1 and 2. These sheets replace the original two sheets, also including Figures 1 and 2. Each figure has been amended to provide text labels to the boxes.

Attachments: Two Replacement Sheets

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REMARKS

Claims 1-13 and 15-36 remain pending in the application, with claims 26-36 having been previously withdrawn from consideration. Claim 14 has been canceled without prejudice or disclaimer. Claims 1, 11, 21, 22, and 23 have been amended without introduction of new matter. Favorable reconsideration is respectfully requested in view of the above amendments and the following remarks.

The drawings were objected to because the figures lack appropriate text labels. In response, submitted herewith are two Replacement Sheets in which text labels have been added in each of Figures 1 and 2, corresponding to items described in the specification on pages 5 and 11, respectively. Accordingly, it is respectfully requested that the objection to the drawings be withdrawn.

Claims 21 and 22 were rejected under 35 U.S.C. § 101 as allegedly being directed to non-statutory subject matter. More particularly, the Office objected that the claims define mere ideas in the abstract that do not apply, involve, use, or advance the technological arts. In response, claims 21 and 22 have been amended by the addition of the feature that the processing steps are carried out "by means of a plurality of look up state machines connected in parallel". This feature is described on page 11 with reference to Figure 2 of the drawings and is thus fully supported.

This feature is one of those on which the present invention is based and reflects the same limitation as in claim 1, for example. Applicant respectfully submits that this limitation is one of the inventive features of the present application (as more fully developed below in connection with the rejection under 35 U.S.C. § 103(a)) and thus applies, involves, uses or advances the technological arts within the meaning of the above entitled statute. Accordingly, it is respectfully requested that the rejection of claims 21 and 22 under Section 101 be withdrawn.

Claims 21 and 22 were rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the enablement requirement. In particular, the Office objected that the specification does not enable one skilled in the art to which the invention pertains to carry out the claimed methods without the use of any computer system components.

In response, it is respectfully submitted that the amendments made to claims 21 and 22, and discussed above with respect to the rejection under Section 101 introduce hardware

components for carrying out the claimed steps. Accordingly, the rejection under the first paragraph of Section 112 should be withdrawn.

Claims 21 and 22 were further rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite. The various concerns expressed in the Office Action are addressed in the following.

Regarding the "method of looking up a value", it is believed that the previously discussed amendment, that is, the addition of the technological limitation that the lookup operation is carried out "by means of a plurality of look up state machines connected in parallel", is sufficient to deal with this particular point.

Regarding the lack of antecedent basis for "the input key", step (a) in each of claims 21 and 22 has been clarified by replacing "a key value" by "an input key value", thereby creating antecedent basis for the input key in step (b) of those claims.

As regards the reference in claim 21 to the feature that "steps (a), (b) and (c) are carried out concurrently" and the corresponding reference in claim 22 to the feature that "steps (b) to (d) are carried out concurrently", these are explained as follows. The purpose of having a plurality of lookup state machines in parallel is not to accelerate the process of looking up *one* value. It is not, therefore, a case of the individual steps (a) to (c) in claim 21 and steps (b) to (d) in claim 22 being carried out concurrently in connection with *one* lookup, as the Office questions. Rather, the parallel state machines enable a plurality of *different* lookup operations to be carried out at the same time as one another. This feature is specifically described in the paragraph beginning on page 3, lines 4-21 of the specification, for example. In particular, it is stated there that *"each look up state machine accesses storage means, preferably comprising a plurality of parallel, independent memory banks, in which the look up table may be constructed on the basis of a trie, more preferably a Patricia tree structure. Such a look up table provides increased performance by doing multiple parallel lookups to multiple memory banks in parallel"*. Again, the paragraph at lines 1 to 8 of page 13 refers to a situation where lookup requests are submitted simultaneously.

In order to make this feature abundantly clear, claims 1, 21 and 22 have been amended by the addition of a limitation qualifying the nature of the concurrency, namely *"whereby to enable multiple look ups relating to a plurality of values and associated key values corresponding to a plurality of input key values to be carried out concurrently."* This

is based on the passages of the as-filed description identified in the immediately preceding paragraph above.

Finally, as regards the reference to "assembling", this is meant to indicate the step peculiar to claim 22, where the results of the various lookup operations pertaining to the predetermined portions of the input key are formed into a single final key value. The wording of claim 22 has therefore been revised to make this clearer.

In view of the foregoing amendments and remarks, claims 21 and 22 are believed to define the invention with sufficient particularity and distinctness to satisfy the requirements of the statute. Accordingly, it is respectfully requested that the rejection of these claims under the second paragraph of Section 112 be withdrawn.

Claims 1-25 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Greene (U.S. Patent No. 6,631,419) in view of Wilkinson III et al. (U.S. Patent No. 6,014,659). This rejection is respectfully traversed.

Dependent claim 14 has been canceled, thereby rendering the rejection of this claim moot.

To address the issue of obviousness with respect to the remaining claims, Applicant believes that it would be most helpful to first appreciate the operation of the invention and the advantages it has over prior art lookup engines and techniques.

In conventional table lookups, a lookup usually follows selected branches of a trie, such as the Patricia trie mentioned in the specification. At each node of a trie, data is stored as a value/key pair, where the value being searched is associated with a key that is input to the trie. Branches separate onto different paths at the nodes. The lookup key is needed to follow a particular branch from that node. To follow every single possible branch from each and every node would be inordinately expensive in terms of time. Therefore, lookups are constructed so that, in the first stage, only the leading bits of a key are used to access the nodes. The next few bits can be skipped in the interests of speed and in the expectation that the search will reach the correct target. However, it is possible that this approach will lead to a false match. In order to check that the "correct" value has been obtained, the prior art invariably carries out a check stage after the search has completed.

In the present invention, information (the "skip value") about the skipped bits (i.e., what those bits are expected to consist of, such as a series of zeroes) is also stored along with the data at the node in question. The key includes information (the "skip count") about the

number of bits to be skipped (see page 6, line 29 through page 7, line 4). The skipped bits of the input key value used to work through the tree can then be compared with the skip value stored with the data at the nodes in order to carry out a check as the search is being performed (i.e., at the same time as the search). In this way, the search can be terminated once a match has been found, as opposed to only terminating the search after completion of the checking operation. The present specification from page 6 onwards explains these features more fully.

The independent claims 1, 21, 22, and 23 have therefore been amended to introduce the feature that each entry stored in the storage means includes a skip value (as well as a value and an associated key value) so that if the skipped bits of the input key value and the associated skip value mismatches, an error message is output to indicate lookup failure. This is particularly described on page 3, lines 10 to 33; page 5, lines 14 to 31; and page 7, lines 1 to 4 of the as-filed application. It can be seen that the addition of the skip value field in the entry adds to the size of the entries but eliminates the need for a final check operation to determine whether the result of the lookup operation is valid.

With that in mind, it is appropriate to consider the effect of the amendment on the cited references, as follows:

Greene teaches a lookup engine comprising a storage means for a plurality of entries, each entry containing a value and an associated key value. The storage means are cascaded so that a node returns either a result or a pointer to an address for the next stage in the cascade. As the Office rightly concludes, Greene does not disclose or teach that the lookup engine comprises a plurality of lookup state machines connected in parallel to enable multiple lookups to be carried out concurrently. Greene does disclose that the cascaded arrangement allows a second lookup request to be commenced as a first lookup request is in operation further into the cascaded structure.

However, it is not a simple case of re-configuring the search engine in Greene by adding a plurality of lookup state machines in parallel in order to arrive at the presently claimed embodiments. On the contrary, the claims require that each entry include a skip value field in order to eliminate the need for a final check operation.

Wilkenson fails to make up for the deficiencies of Greene. Wilkinson discloses a trie searching procedure in which nodes are selectively eliminated in order to reduce memory storage. When a node is encountered that (i) has a single "child" node dependent from it and (ii) contains no result matching the particular segment of the search request/argument or has

the same result as the parent, that node is eliminated from the search path. If so, a digit string is established that contains all of the segments of the eliminated (or "skipped") node or nodes. Each digit of the string is compared against each segment of the search argument and the search proceeds only if all segments match, otherwise the search terminates at the node preceding the digit string. The digit string itself is stored at the *child* node. To that extent, the data being searched in a given node is not all concentrated at *that* node, as is the case with Applicant's invention as claimed in the amended claims submitted herewith, that is, where the key value, the associated value and the skip value are all stored at each node.

Moreover, and more significantly, in Wilkinson, the digit string is created "on the fly" as a search argument reaches a particular node satisfying the criteria (i) and (ii) above. In Applicant's invention, *each* trie entry contains a skip value field in which is stored information about the predetermined number of bits to be skipped in the input key and the number of bits to be used to index into the next level (see pages 6 and 7 of Applicant's specification). In Wilkinson, since the digit string is created dynamically, not every node will contain the skip field information. In this significant respect, Wilkinson fails to disclose or suggest the features of Applicant's invention. Page 4 of Applicant's specification acknowledges that trie node entries will be larger in consequence but explains that the cost is worthwhile because of the saving in the post-search memory reference check to establish whether the returned result is valid.

It is therefore respectfully submitted that Wilkinson does not provide the missing link required to take the person of ordinary skill in the art from Greene to the present invention.

Moreover, it is clear that the organization of the component parts of Applicant's amended claim 1 permit a plurality of *different* requests for *different* items of information/data to be serviced concurrently by the plurality of parallel paths and state machines. In Wilkinson, only a *single* request can be handled at any one time. In the present invention, multiple state machines are used, effectively, to accelerate the *overall* look-up process, where the ability to look up several values in parallel means that *all* of the look-ups can be completed faster, (i.e., the latency for any given search request is reduced). Significantly, each of the concurrent look-ups in the present invention can take a different amount of time and can emerge in a different order to the original request. Hence the application of a tag, as specifically claimed in claims 9 and 10. In the present invention, multiple look-ups in respect of different data can be carried out at the same time within the

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same table. All of the finite state machines reference the same lookup table data. The prior art systems may perform multiple lookups but they do so in different lookup tables.

Claims 1, 21, 22 and 23 as now presented specify the features of multiple state machines and multiple look-ups relating to a plurality of values and associated key values corresponding to a plurality of input key values. Moreover, these claims also stipulate that each entry includes a skip value such that if the skipped bits of the input key value and the associated skip value mismatches, an error message is output to indicate lookup failure.

For at least the foregoing reasons, it is respectfully asserted that the independent claims 1, 21, 22, and 23 are patentably distinguishable over the Greene and Wilkinson documents, regardless of whether these documents are considered individually or in combination. The remaining dependent claims 2-13, 15-20, and 24-25 inherit the features of their respective base claims, and are therefore patentable for at least the same reasons as those set forth above. Accordingly, it is respectfully requested that the rejection of claims 1-13 and 15-25 under Section 103(a) be withdrawn.

The application is believed to be in condition for allowance. Prompt notice of same is respectfully requested.

Respectfully submitted,

Potomac Patent Group PLLC

Date: July 7, 2005   By: _____
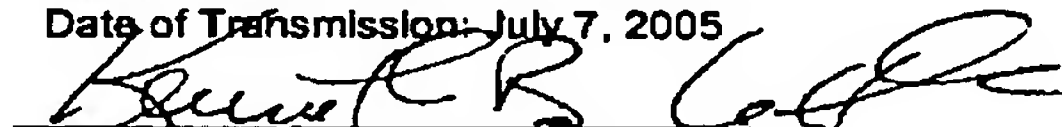   Kenneth B. Leffler
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